Office of Energy Efficiency and Renewable Energy

Carbon Foams for Thermal Management

Background

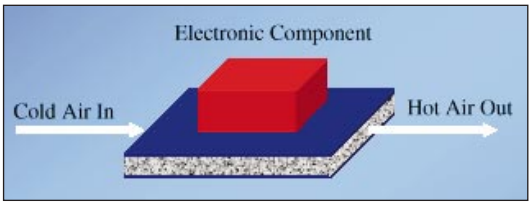
While investigating ways to make dense carbon-carbon materials, researchers at Oak Ridge National Laboratory produced a carbon foam that exhibited astonishing heat transfer characteristics. The thermal conductivity of the carbon foam is five times that of copper and four times that of aluminum. The researchers were able to braze the carbon foam to copper and aluminum without significantly reducing its thermal properties, thus making it a likely candidate for use as a passive cooling device for electronic components. Replacing existing active cooling devices with these passive cooling devices will reduce the complexity, cost, and packaging size of these electronic systems.

Accomplishments

- Thermal conductivity of the foam has been increased by 50% to 150 W/mK.
- Foam exhibits compressive strengths comparable to Kevlar® honeycomb composites at similar densities.
- Material withstands temperatures as high as 3000°C.

Benefits

- Because of its open cellular structure, the foam is a prime candidate for use as a porous media heat exchanger for automotive high-power electronic components.
- Most substrates for high-power electronics include a water-cooled aluminum or copper core mounted below the circuitry. Used as the heat exchanger's core material, the new graphite foam can dramatically increase the effective heat transfer, eliminating the need for water cooling.



Future Activities

- Optimize fabrication process to control thermal conductivity, electrical conductivity, strength, brittleness, pore size, permeability, and heat transfer coefficient.

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April 1999